

WHAT IS CLAIMED IS:

1. A solid electrolytic capacitor comprising:
an anode that contains a valve-action metal;
a dielectric film overlying said anode;
5 a protective coating overlying said dielectric film, wherein said protective coating contains a relatively insulative, resinous material; and
a conductive polymer coating overlying said protective coating.
2. A solid electrolytic capacitor as defined in claim 1, wherein said resinous material is selected from the group consisting of polyurethane,
10 polystyrene, esters of unsaturated or saturated fatty acids, and combinations thereof.
3. A solid electrolytic capacitor as defined in claim 1, wherein said resinous material contains esters of unsaturated or saturated fatty acids or derivatives thereof.
- 15 4. A solid electrolytic capacitor as defined in claim 1, wherein said resinous material contains a drying oil or derivatives thereof.
5. A solid electrolytic capacitor as defined in claim 4, wherein said drying oil is selected from the group consisting of olive oil, linseed oil, tung oil, castor oil, soybean oil, shellac, and derivatives thereof.
- 20 6. A solid electrolytic capacitor as defined in claim 1, wherein said resinous material contains shellac or derivatives thereof.
7. A solid electrolytic capacitor as defined in claim 1, wherein said valve-action metal is tantalum or niobium.
8. A solid electrolytic capacitor as defined in claim 1, wherein said
25 conductive polymer is selected from the group consisting of polypyrroles, polythiophenes, polyanilines, polyacetylenes, poly-p-phenylenes, and derivatives thereof.
9. A solid electrolytic capacitor as defined in claim 1, wherein the capacitor has a normalized leakage current of less than about 0.1

$\mu\text{A}/\mu\text{F}\cdot\text{V}$, where μA is the measured leakage current of the capacitor in microamps and $\mu\text{F}\cdot\text{V}$ is the product of the capacitance and the rated voltage of the capacitor.

5 10. A solid electrolytic capacitor as defined in claim 1, wherein the capacitor has a normalized leakage current of less than about 0.01 $\mu\text{A}/\mu\text{F}\cdot\text{V}$, where μA is the measured leakage current of the capacitor in microamps and $\mu\text{F}\cdot\text{V}$ is the product of the capacitance and the rated voltage of the capacitor.

10 11. A solid electrolytic capacitor as defined in claim 1, wherein the capacitor has a dissipation factor of less than about 10%.

12. A solid electrolytic capacitor as defined in claim 1, wherein the capacitor has a dissipation factor of less than about 5%.

15 13. A solid electrolytic capacitor as defined in claim 1, wherein the capacitor has a equivalent series resistance of less than about 1000 milliohms.

14. A solid electrolytic capacitor as defined in claim 1, wherein the capacitor has an equivalent series resistance of less than about 500 milliohms.

20 15. A solid electrolytic capacitor as defined in claim 1, wherein the relatively insulative, resinous material has a resistivity greater than about 1×10^{10} ohms-cm.

25 16. A solid electrolytic capacitor comprising:
an anode that contains a valve-action metal;
a dielectric film overlying said anode;
a protective coating overlying said dielectric film, wherein said protective coating contains esters of unsaturated or saturated fatty acids;
and

a conductive polymer coating overlying said protective coating.

17. A solid electrolytic capacitor as defined in claim 17, wherein

said protective coating includes at least one drying oil or derivatives thereof.

18. A solid electrolytic capacitor as defined in claim 16, wherein said drying oil is selected from the group consisting of olive oil, linseed oil, tung oil, castor oil, soybean oil, shellac, and derivatives thereof.

19. A solid electrolytic capacitor as defined in claim 16, wherein said protective coating contains shellac or derivatives thereof.

20. A solid electrolytic capacitor as defined in claim 16, wherein said valve-action metal is tantalum or niobium.

21. A solid electrolytic capacitor as defined in claim 16, wherein said conductive polymer is selected from the group consisting of polypyrroles, polythiophenes, polyanilines, polyacetylenes, poly-p-phenylenes, and derivatives thereof.

22. A solid electrolytic capacitor as defined in claim 16, wherein the capacitor has a normalized leakage current of less than about $0.1 \mu\text{A}/\mu\text{F}\cdot\text{V}$, where μA is the measured leakage current of the capacitor in microamps and $\mu\text{F}\cdot\text{V}$ is the product of the capacitance and the rated voltage of the capacitor.

23. A solid electrolytic capacitor as defined in claim 16, wherein the capacitor has a normalized leakage current of less than about $0.01 \mu\text{A}/\mu\text{F}\cdot\text{V}$, where μA is the measured leakage current of the capacitor in microamps and $\mu\text{F}\cdot\text{V}$ is the product of the capacitance and the rated voltage of the capacitor.

24. A solid electrolytic capacitor as defined in claim 16, wherein the capacitor has a dissipation factor of less than about 10%.

25. A solid electrolytic capacitor as defined in claim 16, wherein the capacitor has a dissipation factor of less than about 5%.

26. A solid electrolytic capacitor as defined in claim 16, wherein the capacitor has a equivalent series resistance of less than about 1000

milliohms.

27. A solid electrolytic capacitor as defined in claim 16, wherein the capacitor has a equivalent series resistance of less than about 500 milliohms.

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28. A solid electrolytic capacitor comprising:

an anode that contains a valve-action metal;

a dielectric film overlying said anode;

a protective coating overlying said dielectric film, wherein said protective coating contains shellac or derivatives thereof; and

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a conductive polymer coating overlying said protective coating.

29. A method for forming a solid electrolytic capacitor, said method comprising:

forming an anode that contains a valve-action metal;

anodizing a surface of said anode to form a dielectric film;

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forming a protective coating on said dielectric film, said protective coating containing a relatively insulative, resinous material; and

forming a conductive polymer coating.

30. A method as defined in claim 29, wherein said resinous material contains esters of unsaturated or saturated fatty acids.

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31. A method as defined in claim 29, wherein said resinous material contains at least one drying oil or derivatives thereof.

32. A method as defined in claim 31, wherein said drying oil is selected from the group consisting of olive oil, linseed oil, tung oil, castor oil, soybean oil, shellac, and derivatives thereof.

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33. A method as defined in claim 29, wherein said protective coating contains shellac or derivatives thereof.

34. A method as defined in claim 29, wherein said protective coating is formed by from a solution containing said relatively insulative, resinous material.

35. A method as defined in claim 34, wherein said solution further contains a non-aqueous solvent having a boiling point greater than about 80°C.

5 36. A method as defined in claim 34, wherein said solution further contains a non-aqueous solvent having a boiling point greater than about 120°C.

37. A method as defined in claim 34, wherein said solution further contains a non-aqueous solvent having a boiling point greater than about 150°C.

10 39. A method as defined in claim 34, wherein said protective coating is formed by dipping said anode into said solution.

40. A method as defined in claim 29, further comprising applying a curing agent to the protective coating before forming said conductive polymer coating.

15 41. A method as defined in claim 39, wherein said curing agent contains sulfuric acid.

42. A method as defined in claim 29, wherein said protective coating includes multiple layers.

20 43. A method as defined in claim 42, wherein each protective coating layer is dried at a temperature ranging from about 30°C to about 300°C.

44. A method as defined in claim 42, wherein each protective coating layer is dried at a temperature ranging from about 50°C to about 150°C.

25 45. A method for forming a solid electrolytic capacitor, said method comprising:

forming an anode that contains a valve-action metal;
anodizing a surface of said anode to form a dielectric film;
applying a solution to said anodized anode that contains a

conductive polymer catalyst and a relatively insulative, resinous material;
and

thereafter, applying a conductive monomer to said anodized anode,
wherein said conductive monomer polymerizes to form a conductive
polymer coating.

46. A method for forming a solid electrolytic capacitor, said method
comprising:

forming an anode that contains a valve-action metal;

anodizing a surface of said anode to form a dielectric film;

applying a solution to said anodized anode that contains a
conductive monomer and a relatively insulative, resinous material; and

thereafter, applying a conductive monomer catalyst to said
anodized anode, wherein said conductive monomer polymerizes to form a
conductive polymer coating.

47. A method for forming a solid electrolytic capacitor, said method
comprising:

forming an anode that contains a valve-action metal;

anodizing a surface of said anode to form a dielectric film;

applying a solution to said anodized anode that contains a
conductive monomer, a catalyst for said conductive monomer, and a
relatively insulative, resinous material, wherein said conductive monomer
polymerizes to form a conductive polymer coating.